

*Please provide the following information, and submit to the NOAA DM Plan Repository.*

### **Reference to Master DM Plan (if applicable)**

*As stated in Section IV, Requirement 1.3, DM Plans may be hierarchical. If this DM Plan inherits provisions from a higher-level DM Plan already submitted to the Repository, then this more-specific Plan only needs to provide information that differs from what was provided in the Master DM Plan.*

URL of higher-level DM Plan (if any) as submitted to DM Plan Repository:

## **1. General Description of Data to be Managed**

### **1.1. Name of the Data, data collection Project, or data-producing Program:**

Linkages between reef fish demographics and benthic habitat characteristics in Tutuila, American Samoa and Main Hawaiian Islands

### **1.2. Summary description of the data:**

Benthic habitats play vital roles in the distribution and abundances of marine resources. Understanding how fish populations respond to variability of benthic habitat characteristics is essential for effective coral reef management and monitoring. A pilot study was conducted by NOAA Pacific Islands Fisheries Science Center (PIFSC) Coral Reef Ecosystem Program (CREP) to examine the relationships and linkages between the geomorphological benthic characteristics and fish demographics in Tutuila, American Samoa and the analysis was later expanded to the main Hawaiian Islands.

Geomorphological metrics characterizing benthic habitats including slope, rugosity, curvature, and convexity were derived using best available bathymetry for each area. The fish assemblages and abundance data were collected during Rapid Ecological Assessment (REA) surveys from 2010 to 2016. These fish data were collected according to a stratified random survey design using depth as an environmental correlate. Based on the analysis for Tutuila, American Samoa, preliminary evidence was found that using both depth and convexity to define strata may result in more precise estimates of fish biomass. This analysis was expanded to the main Hawaiian Islands for the subsequent year of the project, and found that including several other metrics in CREP's sampling design can enhance the estimates of fish biomass.

Results and data from the analysis for Tutuila, American Samoa can be accessed online via the Pacific Islands Benthic Habitat Mapping Center website at [http://www.soest.hawaii.edu/pibhmc/pibhmc\\_documentation.htm#other\\_pubs](http://www.soest.hawaii.edu/pibhmc/pibhmc_documentation.htm#other_pubs).

The PIFSC administrative report from the analysis for the main Hawaiian Islands is in review as of Aug 2017 and will be available on the PIFSC website once published at [https://www.pifsc.noaa.gov/library/staff\\_publications.php](https://www.pifsc.noaa.gov/library/staff_publications.php).

### **1.3. Is this a one-time data collection, or an ongoing series of measurements?**

One-time data collection

**1.4. Actual or planned temporal coverage of the data:**

2004 to 2006, 2010 to 2015, 2015-03 to 2015-09, 2010 to 2016, 2016-12 to 2017-05, 2013

**1.5. Actual or planned geographic coverage of the data:**

W: -170.924, E: -170.495, N: -14.195, S: -14.385

Tutuila Island, American Samoa

W: -160.4, E: -154.7, N: 22.4, S: 18.8

The main Hawaiian Islands

**1.6. Type(s) of data:**

*(e.g., digital numeric data, imagery, photographs, video, audio, database, tabular data, etc.)*

Report and source data (CSV files) used in the analysis

**1.7. Data collection method(s):**

*(e.g., satellite, airplane, unmanned aerial system, radar, weather station, moored buoy, research vessel, autonomous underwater vehicle, animal tagging, manual surveys, enforcement activities, numerical model, etc.)*

Instrument: Not applicable

Platform: Not applicable

Physical Collection / Fishing Gear: Not applicable

**1.8. If data are from a NOAA Observing System of Record, indicate name of system:****1.8.1. If data are from another observing system, please specify:****2. Point of Contact for this Data Management Plan (author or maintainer)****2.1. Name:**

Annette M DesRochers

**2.2. Title:**

Metadata Contact

**2.3. Affiliation or facility:****2.4. E-mail address:**

annette.desrochers@noaa.gov

**2.5. Phone number:**

(808)725-5461

**3. Responsible Party for Data Management**

*Program Managers, or their designee, shall be responsible for assuring the proper management of the data produced by their Program. Please indicate the responsible party below.*

**3.1. Name:**

Kelvin D Gorospe

**3.2. Title:**

Data Steward

**4. Resources**

*Programs must identify resources within their own budget for managing the data they produce.*

**4.1. Have resources for management of these data been identified?**

Yes

**4.2. Approximate percentage of the budget for these data devoted to data management (specify percentage or "unknown"):**

Unknown

**5. Data Lineage and Quality**

*NOAA has issued Information Quality Guidelines for ensuring and maximizing the quality, objectivity, utility, and integrity of information which it disseminates.*

**5.1. Processing workflow of the data from collection or acquisition to making it publicly accessible**

*(describe or provide URL of description):*

Lineage Statement:

This project involves two primary analyses: one is to derive geomorphological data from gridded bathymetry, and the other is to examine the linkage between derived geomorphological data and fish demographic data from in-situ biological surveys. The analysis was performed for Tutuila, American Samoa during first year of the project, and then for Main Hawaiian Islands during the second year of the project.

Process Steps:

- Source gridded multibeam bathymetry data for Tutuila, American Samoa. ( Citation: Pacific Islands Benthic Habitat Mapping Center (PIBHC), Coral Reef Ecosystem Division (CRED), Pacific Islands Fisheries Science Center (PIFSC), National Marine Fisheries Service (NMFS), National Oceanic and Atmospheric Administration (NOAA). Gridded bathymetry of Tutuila Island, American Samoa, South Pacific. )
- The first step was to generate a series of geomorphology benthic variables from multibeam bathymetry for the nearshore environment of Tutuila, American Samoa using open source GIS software, System for Automated Geoscientific Analyses ( SAGA) 2.1.4. Six geomorphology variables were derived for this study. Detailed descriptions of the tools used are available in Watkins (2015). Slope, aspect and profile curvature were derived from the multibeam bathymetry with the Slope, Aspect, Curvature tool in SAGA using the default option of the nine parameter 2nd order polynomial method. Real surface area was derived using the Real Surface Area tool in SAGA, which was then also used to calculate rugosity, a measure of roughness, derived by dividing real surface area by the geometric surface area.

Terrain surface convexity is measured as the percentage of convex-upward cells within a constant radius of ten cells. The terrain surface convexity tool in SAGA was used to derive this variable. (Citation: Watkins, R. 2015. Terrain Metrics and landscape Characterization from Bathymetric Data; SAGA GIS Methods and Command Sequences. Internal Report)

- For each of the benthic geomorphology variables, site-specific values were extracted for each fish survey location in Tutuila using the Sample tool available in Esri's ArcToolbox. In addition, geomorphology values were averaged across all cells within the available data within a radius of 30, 50, and 100 meters from the fish survey site. The Buffer tool in Esri's ArcToolbox was used to create the zone shapefile with the radius of 30, 50, and 100 meters of each fish survey site. The Zonal Statistics tool in Esri's ArcToolbox was then used to generate the mean value for each geomorphology variable for each site.

- A total of nine fish biomass metrics were derived from NOAA Coral Reef Ecosystem Program Rapid Ecological Assessment (REA) fish surveys for each survey site. The metrics include four trophic groups (primary consumers, secondary consumers, planktivores, piscivores), three size classes (0-20 centimeters; 20-50 centimeters; and 50+ centimeters), as well as parrotfishes, and total fish biomass. (Citation: National Coral Reef Monitoring Program: Stratified Random Surveys (StRS) of Reef Fish, including Benthic Estimate Data of the Hawaiian Archipelago)

- Scatterplots and trend lines were created to reveal patterns between each fish biomass metric and each of the geomorphology metrics. Based on this, convexity was chosen as a promising geomorphology metric that could potentially be informative for surveying fish biomass. Using the scatterplots and trend lines as a guide, bin boundaries for high, moderate, and low convexity were selected. (Citation: Gorospe, K.D., Acoba, T., Rooney, J. 2015. A preliminary analysis examining linkages between reef fish assemblages and benthic habitat characteristics in Tutuila, American Samoa. Internal Report)

- By combining the current NOAA Coral Reef Ecosystem Program sampling design's depth strata (shallow 0-6 meter depth, moderate 6-18 meter depth, deep 18-30 meter depth) and the new convexity strata, total reef area for each strata combination (e.g., deep and low convexity, deep and moderate convexity, deep and high convexity, moderate depth and low convexity, etc.) was calculated using ArcGIS. (Citation: Gorospe, K.D., Acoba, T., Rooney, J. 2015. A preliminary analysis examining linkages between reef fish assemblages and benthic habitat characteristics in Tutuila, American Samoa. Internal Report)

- Sampling design performance was evaluated for each fish biomass metric, by calculating  $n^*$  (i.e., the number of samples required to attain a target coefficient of variation). This was done for two sampling designs: (1) using depth as a covariate for stratification and (2) using a combination of depth and convexity as covariates for stratification. (Citation: Gorospe, K.D., Acoba, T., Rooney, J. 2015. A preliminary analysis examining linkages between reef fish assemblages and benthic habitat characteristics in Tutuila, American Samoa. Internal Report)

- Steps 1-3 were repeated for the main Hawaiian Islands with the LiDAR data

acquired by U.S. Army Corps of Engineers (USACE), JALBTCX (Joint Airborne Lidar Bathymetry Technical Center of eXpertise). The gridded LiDAR data were downloaded from the NOAA Data Access Viewer (<https://coast.noaa.gov/dataviewer/#/>). In addition to the geomorphologic metrics derived for Tutuila, American Samoa, Slope of Slope was also derived for the main Hawaiian Islands. Due to the large file size of the LiDAR data, the method to calculate the mean and standard deviation values of the metrics for each site was modified by calculating focal mean and standard deviation using Focal Statistics tool in ArcToolbox at radius of 30m, 50m and 100m before assigning value to each site. (Citation: Gorospe KD, Acoba TS. 2017.

A survey design performance analysis examining linkages between reef fish assemblages and benthic morphologies in the Main Hawaiian Islands. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-64, 35 p. )

- Steps 4-5 were repeated for the fish demographic data collected for the main Hawaiian Islands between 2010-2016 with the associated geomorphologic metrics derived from LiDAR. It is found that the means of rugosity, slope, and slope of slope, and standard deviation of profile curvature has correlations with fish biomass metrics, and further analysed to derive  $n^*$  described in Steps 6-7. (Citation: Gorospe KD, Acoba TS. 2017. A survey design performance analysis examining linkages between reef fish assemblages and benthic morphologies in the Main Hawaiian Islands. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-64, 35 p. )

- To demonstrate the improvement of the sampling design efficiency with the geomorphological metrics derived from LiDAR, the  $n^*$  was also calculated with the depth and its geomorphological information from the 50-m grid maps used in the current NCRMP sampling design. (Citation: Gorospe KD, Acoba TS. 2017. A survey design performance analysis examining linkages between reef fish assemblages and benthic morphologies in the Main Hawaiian Islands. U.S. Dept. of Commerce, NOAA Technical Memorandum NOAA-TM-NMFS-PIFSC-64, 35 p. )

**5.1.1. If data at different stages of the workflow, or products derived from these data, are subject to a separate data management plan, provide reference to other plan:**

**5.2. Quality control procedures employed (describe or provide URL of description):**

All geomorphological data were derived using SAGA. Some data were cross-checked with data derived using ArcGIS and the Benthic Terrain Modeler (BTM) ArcGIS extension. Sanity checks were performed to examine the process of spatially correlating the gridded bathymetry and geomorphological data with fish demographic data.

## **6. Data Documentation**

*The EDMC Data Documentation Procedural Directive requires that NOAA data be well documented, specifies the use of ISO 19115 and related standards for documentation of new data, and provides links to resources and tools for metadata creation and validation.*

**6.1. Does metadata comply with EDMC Data Documentation directive?**

No

**6.1.1. If metadata are non-existent or non-compliant, please explain:**

Missing/invalid information:

- 7.2. Name of organization of facility providing data access
- 7.2.1. If data hosting service is needed, please indicate

**6.2. Name of organization or facility providing metadata hosting:**

NMFS Office of Science and Technology

**6.2.1. If service is needed for metadata hosting, please indicate:****6.3. URL of metadata folder or data catalog, if known:**

<https://www.fisheries.noaa.gov/inport/item/26865>

**6.4. Process for producing and maintaining metadata**

(describe or provide URL of description):

Metadata produced and maintained in accordance with the NOAA Data Documentation Procedural Directive: [https://nosc.noaa.gov/EDMC/DAARWG/docs/EDMC\\_PD-Data\\_Documentation\\_v1.pdf](https://nosc.noaa.gov/EDMC/DAARWG/docs/EDMC_PD-Data_Documentation_v1.pdf)

**7. Data Access**

*NAO 212-15 states that access to environmental data may only be restricted when distribution is explicitly limited by law, regulation, policy (such as those applicable to personally identifiable information or protected critical infrastructure information or proprietary trade information) or by security requirements. The EDMC Data Access Procedural Directive contains specific guidance, recommends the use of open-standard, interoperable, non-proprietary web services, provides information about resources and tools to enable data access, and includes a Waiver to be submitted to justify any approach other than full, unrestricted public access.*

**7.1. Do these data comply with the Data Access directive?**

Yes

**7.1.1. If the data are not to be made available to the public at all, or with limitations, has a Waiver (Appendix A of Data Access directive) been filed?****7.1.2. If there are limitations to public data access, describe how data are protected from unauthorized access or disclosure:****7.2. Name of organization of facility providing data access:****7.2.1. If data hosting service is needed, please indicate:****7.2.2. URL of data access service, if known:**

ftp://ftp.soest.hawaii.edu/pibhmc/website/webdocs/documentation/Archive\_LinkagesRawData.zip  
ftp://ftp.soest.hawaii.edu/pibhmc/website/webdocs/documentation/LinkagesReport\_FINAL.pdf  
ftp://ftp.soest.hawaii.edu/pibhmc/website/webdocs/documentation/linkages\_project\_methods\_final.p

**7.3. Data access methods or services offered:**

Data can be accessed online via the Pacific Islands Benthic Habitat Mapping Center website.

**7.4. Approximate delay between data collection and dissemination:**

Unknown

**7.4.1. If delay is longer than latency of automated processing, indicate under what authority data access is delayed:****8. Data Preservation and Protection**

*The NOAA Procedure for Scientific Records Appraisal and Archive Approval describes how to identify, appraise and decide what scientific records are to be preserved in a NOAA archive.*

**8.1. Actual or planned long-term data archive location:**

*(Specify NCEI-MD, NCEI-CO, NCEI-NC, NCEI-MS, World Data Center (WDC) facility, Other, To Be Determined, Unable to Archive, or No Archiving Intended)*

Other

**8.1.1. If World Data Center or Other, specify:**

Pacific Islands Benthic Habitat Mapping Center

**8.1.2. If To Be Determined, Unable to Archive or No Archiving Intended, explain:****8.2. Data storage facility prior to being sent to an archive facility (if any):**

Pacific Islands Fisheries Science Center - Honolulu, HI

**8.3. Approximate delay between data collection and submission to an archive facility:**

Unknown

**8.4. How will the data be protected from accidental or malicious modification or deletion prior to receipt by the archive?**

*Discuss data back-up, disaster recovery/contingency planning, and off-site data storage relevant to the data collection*

University of Hawaii School of Ocean and Earth Science and Technology, NOAA IRC and NOAA Fisheries ITS resources and assets.

**9. Additional Line Office or Staff Office Questions**

*Line and Staff Offices may extend this template by inserting additional questions in this section.*